

# 11.4 The reactions of chlorine

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Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 11 marks

**KEY WORDS** disproportionation 歧化 • water purification 水净化 • bacteria 细菌  
• oxidation number 氧化数

## Objective

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Build the skills to answer exam questions on the **reactions of chlorine** — its **disproportionation** 歧化 with sodium hydroxide, and its use in **water purification** 水净化.

**You must be able to:**

- interpret chlorine's reactions with cold and hot NaOH as disproportionation
- use oxidation numbers to show the disproportionation
- explain the use of chlorine in water purification

## 1 Worked examples

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### ■ Chlorine with sodium hydroxide

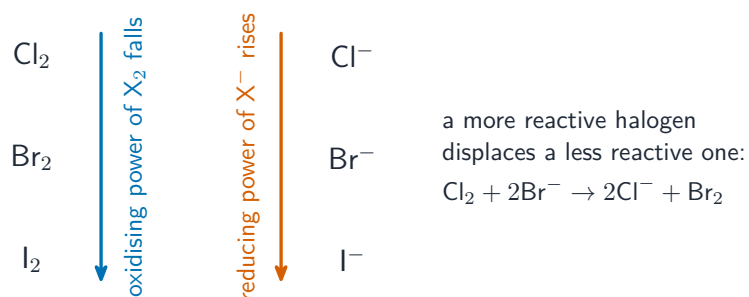
- **cold, dilute** NaOH:  $\text{Cl}_2 + 2\text{NaOH} \rightarrow \text{NaCl} + \text{NaClO} + \text{H}_2\text{O}$ .
- **hot, concentrated** NaOH:  $3\text{Cl}_2 + 6\text{NaOH} \rightarrow 5\text{NaCl} + \text{NaClO}_3 + 3\text{H}_2\text{O}$ .

Both are **disproportionation**: chlorine (0) is both oxidised (to +1 in  $\text{ClO}^-$ , or +5 in  $\text{ClO}_3^-$ ) and reduced (to  $-1$  in  $\text{Cl}^-$ ).

### ■ Water purification



*A little chlorine kills bacteria, making water safe to drink*



*Chlorine is a strong oxidiser in its reactions*

$\text{Cl}_2 + \text{H}_2\text{O} \rightleftharpoons \text{HOCl} + \text{HCl}$ . The active species **HOCl** and **ClO<sup>-</sup>** kill **bacteria** 细菌.

## 2 Practice

**2.1** Write the equation for chlorine reacting with cold, dilute sodium hydroxide. [1]

**2.2** Name the active species, formed when chlorine reacts with water, that kills bacteria. [1]

### 3 Exam-style questions

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**3.1** Chlorine reacting with cold dilute NaOH is a disproportionation reaction because:[1]

|   |   |
|---|---|
| A | B |
| C | D |

- A** chlorine is only oxidised  
**B** chlorine is only reduced  
**C** chlorine is both oxidised and reduced  
**D** no redox occurs

**3.2** What is the oxidation number of chlorine in the chlorate(I) ion,  $\text{ClO}^-$ ? [1]

|   |   |
|---|---|
| A | B |
| C | D |

- A**  $-1$   
**B**  $0$   
**C**  $+1$   
**D**  $+5$

**3.3** When chlorine reacts with hot concentrated sodium hydroxide:

(a) Write the equation. [2]

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(b) Give the oxidation number of chlorine in each chlorine-containing product, and explain why this is disproportionation. [3]

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**3.4** Explain, with an equation, how chlorine makes drinking water safe. [2]

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